COMPASS CRUSADERS

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A WORD TO THE EDUCATOR: The following complete activity involves approximately four hours of time. It is a holistic approach to mathematics, orienteering, map use, journal writing, "art", and physical/life sciences. Due to the variety of resources used during the entire activity, many students have a difficult time in using and relating everything together at once. The activity works best if a variety of students from various grade levels are working together within a small group; this way, they each participate and teach the other members of their group. By utilizing various aspects of the activity over several days/weeks, students may have more time to absorb the variety of resources and to learn how to relate everything together during a single situation. We have attempted to have the students orient around a four-sided shape, but that was too over-whelming to most of them, and they gave up quickly. A triangular shape is easier for the students to manage, and they do not give up.

Purpose: The purpose of this lesson is to learn how to use a compass and a G.P.S. unit AND how to use that knowledge in the field while applying orienteering and mathematical skills.

Teaching Level: This lesson would be appropriate for middle school or high school grade levels with a variety of adaptations possible.

Estimated Sessions: one to five or a half-day field experience

National Geography Standards:
#1 - How to use maps and other geographic representations, tools, and technologies to acquire, process and report information from a spatial perspective.

Indiana Social Studies Academic Standards: (Further standards may be addressed upon completion of all of the classroom and field work.)
Fourth Grade – 4.3.1, and 4.3.2.
Sixth Grade – 6.3.2, and 6.3.13.
High School World Geography – 1.3, 1.4, 2.2, and 2.3.

Objectives: At the conclusion of this lesson, students should be able to:
1. identify and use a compass properly,
2. perform a triangulation-orienteering exercise in the field locating three of three flags,
3. identify and use a G.P.S. (global positioning system) unit, and
4. determine the mathematical procedure necessary to calculate the height of a tree, the perimeter of the triangle traversed, and the area of the triangle traversed.

Materials Required:

- Compasses
- Meter Sticks
- Mirrors (tape the backs with duct tape to prevent shattering)
- Enlarged topographic section of the area in which students are orienteering
- "Compass Crusaders" Resource Packet: Panoramic Drawings, How High is that Tree?, and Heron's Formula instruction sheets.
- Pencils
- 50 meter cord with every 2 meters marked from 1-25
- Group orienteering work-sheets indicating which triangle/trail number that they will be following
- Bags to put the various items necessary into
- Sugar-free candy
- Pieces of cloth with triangle/trail numbers on them
- Each student will be given worksheets for their panoramic drawings, journal writings, and mathematical calculations
- Topographic maps of the field site
- Four or five G.P.S. units (one per Team)

Pre-Activity Work by Teacher: The preparation work by the teacher is relatively extensive, but the activity is well worth the time, and the students learn and apply a variety of skills: scientific, arts, and individual / team empowerment. The teacher must establish the orienteering "course" as appropriate for their school grounds or local park. The teacher must aggregate the materials for the orienteering teams, also.

Procedures:

1. Discuss the cardinal directions (N-0^0, E-90^0, S-180^0, W-270^0) by asking the students questions.
2. Have the students determine which direction, from their current location, is N, S, E, and W; discuss physical features that are located if you walk North, South, East, or West. Try to encourage the students to focus on a 360^0 (panoramic) perspective of where they are.
3. Next, introduce the students to topographic maps. Locate their current location. Locate a variety of other points familiar to the students. Identify the title, scale, legend, grid, and projection. Discuss the purpose of different types of maps. Introduce the students to a G.P.S. unit. Briefly discuss global positioning systems.
4. The next day, divide the students into groups of four to five. These will be their orienteering Teams.
5. Go to the field site and play the *Silva Compass Game* with your students: collect the appropriate items necessary for the game.
6. Discuss what a panoramic view is; practice a panoramic drawing with the students.
7. Calculate a sample tree height problem and perimeter problem in the field as a group.
8. Work as a group with the field site's topographic map noting obvious visual features in relation to the map and to the group's location. Practice using a G.P.S. unit in the field.

9. Review rules of the environment: no littering, attempt to be quiet, work together, and assign duties to each individual. Several of the groups may have one student who does not want to participate, but this will usually be the case; encourage everyone to participate by assigning four-five duties, so, that each student in the group will be responsible for an activity - even if it is carrying the bag. In each bag, place several pencils, a compass, a meter stick, a mirror, a group orienteering work-sheet, and several pieces of candy (energy), the field site's topographic map, and a "Compass Crusaders" Resource Book.
10. The students will be sent out into the field with a pre-determined triangle/trail that they will follow. Students will follow the pre-determined compass heading and distance indicator until they locate a flag with their triangle/trail number on it. At that time, they will re-orient themselves to a new compass heading and distance indicator, searching for a second flag. The second flag will indicate a heading returning the students to their original site (do not tell them this, because they will return to the original site without locating their second flag). You will need to place the flags prior to the event up HIGH IN A TREE and securely tied to the tree (as some Teams may accidentally move another Team's flag)!! At the starting point, first flag and second flag, the Teams will also reference their G.P.S. units.

Evaluation: As each Team returns, check the student's work- topographic map, mathematical calculations, journal writings, panoramic drawings and listen to their tales. If they were unable to locate their flags in the field, send them back out in the appropriate direction to locate the flag. If they were unable to perform the mathematics, assist them, but allow them to do the thinking. The students will be using a variety of resources and, sometimes, this activity is difficult for them. Be patient. It is a complicated activity involving MANY aspects of the student's personal and professional life, but the rewards are usually positive. Each returns feeling extremely successful at a very complicated task. Plus, they are learning many multi-disciplinary, real-life techniques. A majority of the students will return with tales of physical feats and encounters with wild animals, but they are excited and tired and proud.

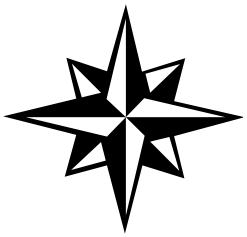
Resources:

Compass Game meters, Compass Game feet, *Silva Camping, Inc.*, Boy Scouts of America, PO Box 1604, National Supply Service, Binghamton NY 13902 Chicago IL (607)779-2264

Topographic Maps (7.5 minute series, 1:24,000 scale), Indiana Department of Natural Resources, Map Sales, 402 West Washington Street, Room 160, Indianapolis IN 46204, 317.232.4180, www.in.gov/dnr/outdoor/canoe/topomaps.htm. Each map is currently $6.00 each.

Mymaps.com is a web site at which you can create your own map.

The United States Geological Survey, National Geographic Society, Garmin, Tech Terrain, and many more companies offer on-line map creation or CD-ROM applications (prices vary). Search for the opportunity that suits your resources and goals.



COMPASS CRUSADERS

RESOURCE BOOK

PANORAMIC DRAWINGS

HOW TO DRAW YOUR SURROUNDINGS

MATERIALS NEEDED:

EU Log/Journal

1) Stand in 1 spot facing North with your compass

2) Locate North on your Compass Crusader page in your journal (use Stop 1 or Stop 2, wherever you are)

3) Draw, in detail, what you see directly ahead of you: trees, picnic tables, grass, water, buildings, etc.

4) Rotate in a circle to face East, then South, then West, and draw continuously as you turn slowly

EVERYONE IS TO DO A PANORAMIC DRAWING AT BOTH STOPS 1 AND 2!!!

HOW HIGH IS THAT TREE?

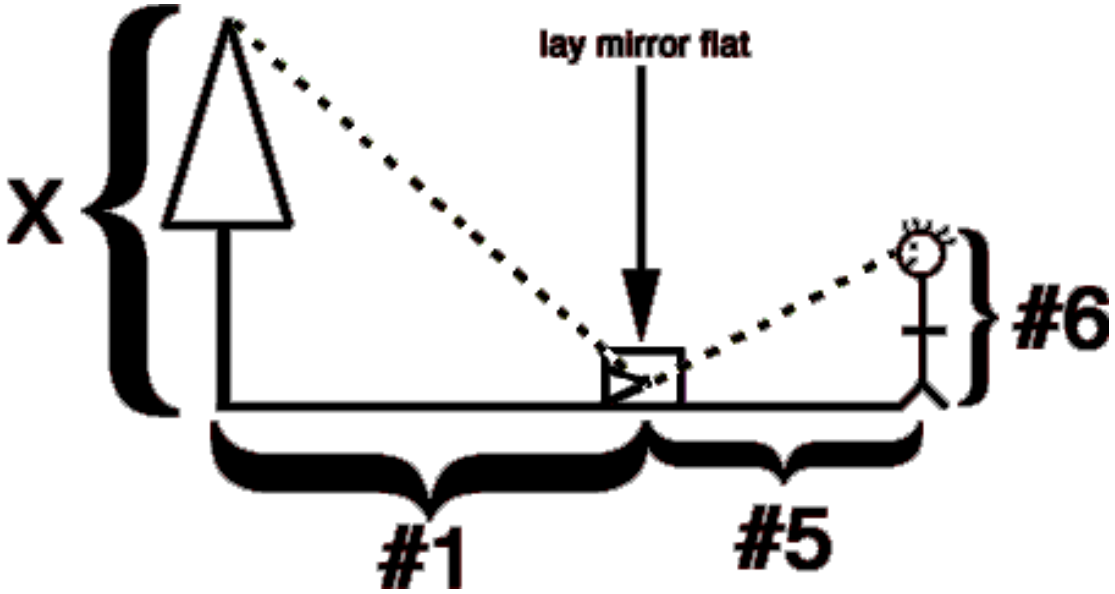
HOW TO CALCULATE THE HEIGHT OF A TREE

MATERIALS NEEDED:

- 1 Mirror Tile
- 1 Meterstick
- 1 Calculator
- Your EU Log/Journal

In order to calculate the height of a tree, you will need to set up a proportion. Follow the steps below and you will soon know how tall that tree is!

1) Measure 5 meters away from your tree in any direction, but towards a clearing area.
2) Put the mirror down right in this spot, reflecting up towards the sky.
3) Have a member of your group stand away from the mirror and have them look in the mirror until they can see the **TOP** of the tree reflected in the mirror.
4) Have that person hold that spot for measuring and stand straight and tall.
5) Measure the distance between the mirror and the person.
6) Measure the height of the person.
7) Set up the proportion as follows:
8) Solve the proportion by **cross multiplying**, then solving for **X**, round your answer to the nearest tenth of a meter.
9) Have **all** group members write the proportion and answer for your tree height in their log. **Label everything neatly and give your work a title at the top of the page in your journal.**



HERON'S FORMULA

HOW TO FIND THE DISTANCE YOU WALKED AND FIND THE AREA OF THE GROUND THAT YOU COVERED

MATERIALS NEEDED:

- EU Log/Journal
- Calculator
- Your topo map with the trail you walked on it

You are to calculate the distance you walked on your trail today. This is called the **PERIMETER** of the traiangulation in which you traveled. This is found by **ADDING** the length of the three sides of your path.

Perimeter Example: If the sides of your triangle are 6.5 hm, 4.2 hm, and 8.4 hm, then you have walked 6.5 + 4.2 + 8.4 = 19.1 hm. This is 1910 meters

Calculate the distance you walked today by finding the perimeter. Then change your answer to meters. **Show all of your calculations and answers in your EU Log/Journal.**

To find the **AREA** of the triangle you covered by walking around the perimeter, you can use **HERON'S FORMULA**:

$$A = \sqrt{s(s-a)(s-b)(s-c)}$$

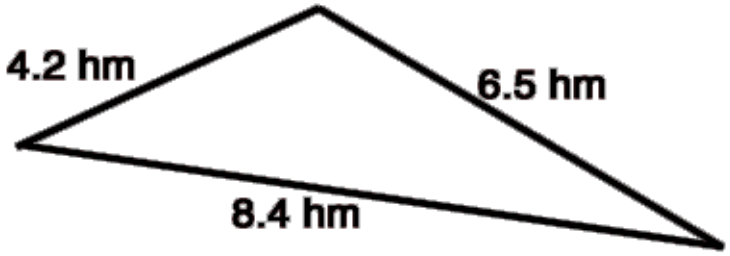
The letter **s** means the SEMIPERIMETER of the triangle you walked. So take your perimeter answer (the one in hectometers) and divide it by 2.

The letters **a**, **b**, and **c**, stand for each of the sides of your triangle, in hectometers please.

Now calculate the area of the triangle you walked by plugging in all of the appropriate numbers ion all of the right places and calculating. Show all of your work in your journal, and put your final answer in square meters.

Ohhhhh…… $\sqrt{}$ means SQUARE ROOT (look on your calculator).

Hear is an example of Heron's Formula used with the same triangle above in the perimeter example:



$S = \frac{(6.5 + 8.4 + 4.2)}{2} = 9.55\text{hm}$

$A = \sqrt{s(s-a)(s-b)(s-c)}$

$A = \sqrt{9.55(9.55-6.5)(9.55-8.4)(9.55-4.2)}$

$A = \sqrt{9.55(3.03)(1.15)(5.35)}$

$A = \sqrt{179.20694}$

A = 13.386819 square hectometers

Rounded to the nearest thousandth is 13.387 square hectometers

This answer in square meters is 1338.7 square meters.

THERE IS THE AREA OF THE TRIANGLE YOU COVERED!

When writing everything in your journal/log, be sure to show all of your work and lablel work well, or you will be asked to do all of this over again!